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Appl. No. 10/500,638
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AMENDMENTS TO THE CLAIMS:

Please cancel without prejudice claims 1, 2 and 8 and amend claims 3-7, 9, 12, 14-16, 20, 21, 23-25 and 32 as follows.

This listing of claims will replace all prior versions, and listings, of claims in the application:

1. (cancelled).

2. (cancelled)

3. (currently amended) A method of generating first and second switching signals for switching first and second switches of a switching circuit that further comprises an output and that receives a DC supply of nominal voltage $+V_S$, and wherein switching between various combinations of on and off states of the first and second switches produces a voltage at the output with pulses at levels of $+V_S$, 0V and $-V_S$;

the method comprising the steps of:

(a) receiving a voltage demand signal indicative of a desired voltage to be supplied at the output in a period; and

(b) generating the first and second switching signals, wherein at least one of the first and second switching signals comprises a single pulse of a determined width within the period, wherein the determined width does not fall below a minimum pulse width, and further, wherein successive transitions between on and off states of the first switching signal or of the second switching signal that occur in different periods are separated in time by a minimum time interval.

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and wherein the determined width is such that the combination of the first and second switching signals when applied to the first and second switches respectively produce an average voltage at the output for the period that is substantially equal to the desired voltage in the period, wherein, at step b), the first switching signal comprises a single pulse of a first determined width within the period and the second switching signal comprises a single pulse of a second determined width within the period, wherein neither said first nor said second determined width falls below said minimum pulse width and wherein said first and second determined widths are such that the combination of the first and second switching signals when applied to the first and second switches respectively produce an average voltage at the output for the period that is substantially equal to the desired voltage.

The method of claim 2, further comprising the step of increasing the first determined width by an amount that is equal in magnitude to the second determined width but compensatory in effect in that a voltage pulse at the output of $+V_S$ or $-V_S$ resulting from the pulse in the second switching signal is balanced by an equal width of voltage pulse at the output of $-V_S$ or $+V_S$ respectively resulting from the increased first determined width of the first switching signal.

4. (currently amended) The method of claim 23, further comprising the step of generating the first and second switching signals according to a rule that the leading and trailing edges of the first switching signal do not coincide with either the leading or trailing edge of the second switching signal.

5. (currently amended) A method of generating first and second switching signals for switching first and second switches of a switching circuit that further comprises an output and

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that receives a DC supply of nominal voltage $+V_S$, and wherein switching between various combinations of on and off states of the first and second switches produces a voltage at the output with pulses at levels of $+V_S$, 0V and $-V_S$;

the method comprising the steps of:

(a) receiving a voltage demand signal indicative of a desired voltage to be supplied at the output in a period; and

(b) generating the first and second switching signals, wherein at least one of the first and second switching signals comprises a single pulse of a determined width within the period, wherein the determined width does not fall below a minimum pulse width, and further, wherein successive transitions between on and off states of the first switching signal or of the second switching signal that occur in different periods are separated in time by a minimum time interval, and wherein the determined width is such that the combination of the first and second switching signals when applied to the first and second switches respectively produce an average voltage at the output for the period that is substantially equal to the desired voltage in the period.
~~The method of claim 1, further comprising the step of generating the first and second switching signals according to a rule that any pulse should be positioned symmetrically about the centre of the period.~~

6. (currently amended) A method of generating first and second switching signals for switching first and second switches of a switching circuit that further comprises an output and that receives a DC supply of nominal voltage $+V_S$, and wherein switching between various combinations of on and off states of the first and second switches produces a voltage at the output with pulses at levels of $+V_S$, 0V and $-V_S$;

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the method comprising the steps of:

(a) receiving a voltage demand signal indicative of a desired voltage to be supplied at the output in a period; and

(b) generating the first and second switching signals, wherein at least one of the first and second switching signals comprises a single pulse of a determined width within the period, wherein the determined width does not fall below a minimum pulse width, and further, wherein successive transitions between on and off states of the first switching signal or of the second switching signal that occur in different periods are separated in time by a minimum time interval, and wherein the determined width is such that the combination of the first and second switching signals when applied to the first and second switches respectively produce an average voltage at the output for the period that is substantially equal to the desired voltage in the period.

The method of claim 1, further comprising the step of generating the first and second switching signals according to the rule that where pulses cannot be centred symmetrically, the longer and shorter sides of the asymmetric pulses are alternated between the leading edge side and the trailing edge side for successive asymmetric pulses.

7.(currently amended) A method of generating first and second switching signals for switching first and second switches of a switching circuit that further comprises an output and that receives a DC supply of nominal voltage $+V_S$, and wherein switching between various combinations of on and off states of the first and second switches produces a voltage at the output with pulses at levels of $+V_S$, 0V and $-V_S$;

the method comprising the steps of:

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(a) receiving a voltage demand signal indicative of a desired voltage to be supplied at the output in a period; and

(b) generating the first and second switching signals, wherein at least one of the first and second switching signals comprises a single pulse of a determined width within the period, wherein the determined width does not fall below a minimum pulse width, and further, wherein successive transitions between on and off states of the first switching signal or of the second switching signal that occur in different periods are separated in time by a minimum time interval, and wherein the determined width is such that the combination of the first and second switching signals when applied to the first and second switches respectively produce an average voltage at the output for the period that is substantially equal to the desired voltage in the period.
~~The method of claim 1 further comprising the step of noise shaping the first and second switching signals.~~

8. (cancelled).

9. (currently amended) A method of operating a switching circuit comprising a bridge circuit having an input that receives a DC supply of nominal voltage $+V_s$, an output and first and second arms having first and second switches respectively, the first and second arms being connected to opposed ends of the output,

the method comprising the steps of:

(a) generating pulsed first and/or second switching signals, wherein at least one of the first and second switching signals comprises a single pulse of a determined width within the period, wherein the determined width does not fall below a minimum pulse width, and further,

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wherein successive transitions between on and off states of the first switching signal or of the second switching signal that occur in different periods are separated in time by a minimum time interval, and wherein the determined width is such that the combination of the first and second switching signals when applied to the first and second switches respectively produce an average voltage at the output for the period that is substantially equal to the desired voltage in the period;
and

(b) supplying the first and second switching signals to the first and second switches respectively thereby to cause the first and second switches to switch between on and off states, switching between various combinations of on and off states producing an electrical signal across the output with voltage pulses at levels of $+V_S$, 0V and $-V_S$ and with an average voltage for the period substantially equal to the desired voltage
~~The method of claim 8, wherein either the first or second determined pulse width is generated with reference to a voltage signal indicative of the DC supply voltage such that the determined pulse width compensates for fluctuations in the DC supply.~~

10. (previously presented) The method of claim 9, wherein the voltage signal is passed through a filter to obtain a predictive measure of fluctuations in the DC supply.

11. (original) The method of claim 10, wherein the voltage signal is passed through a finite impulse response filter.

12. (currently amended) A method of operating a switching circuit comprising a bridge circuit having an input that receives a DC supply of nominal voltage $+V_S$, an output and first and

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second arms having first and second switches respectively, the first and second arms being connected to opposed ends of the output,

the method comprising the steps of:

(a) generating pulsed first and/or second switching signals, wherein at least one of the first and second switching signals comprises a single pulse of a determined width within the period, wherein the determined width does not fall below a minimum pulse width, and further, wherein successive transitions between on and off states of the first switching signal or of the second switching signal that occur in different periods are separated in time by a minimum time interval, and wherein the determined width is such that the combination of the first and second switching signals when applied to the first and second switches respectively produce an average voltage at the output for the period that is substantially equal to the desired voltage in the period;
and

(b) supplying the first and second switching signals to the first and second switches respectively thereby to cause the first and second switches to switch between on and off states, switching between various combinations of on and off states producing an electrical signal across the output with voltage pulses at levels of $+V_S$, 0V and $-V_S$ and with an average voltage for the period substantially equal to the desired voltage
The method of claim 8, wherein either the first or second determined pulse width is generated to include an adjustment to the width of the pulse to compensate for a voltage drop across a diode and/or transistor in the bridge circuit.

13. (previously presented) The method of claim 12, wherein the adjustment to the pulse width is calculated with reference to a current signal indicative of the current flowing through the output and to a representative resistance of the diode or transistor.

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14. (currently amended) A method of operating a switching circuit comprising a bridge circuit having an input that receives a DC supply of nominal voltage $+V_S$, an output and first and second arms having first and second switches respectively, the first and second arms being connected to opposed ends of the output,

the method comprising the steps of:

(a) generating pulsed first and/or second switching signals, wherein at least one of the first and second switching signals comprises a single pulse of a determined width within the period, wherein the determined width does not fall below a minimum pulse width, and further, wherein successive transitions between on and off states of the first switching signal or of the second switching signal that occur in different periods are separated in time by a minimum time interval, and wherein the determined width is such that the combination of the first and second switching signals when applied to the first and second switches respectively produce an average voltage at the output for the period that is substantially equal to the desired voltage in the period;
and

(b) supplying the first and second switching signals to the first and second switches respectively thereby to cause the first and second switches to switch between on and off states, switching between various combinations of on and off states producing an electrical signal across the output with voltage pulses at levels of $+V_S$, 0V and $-V_S$ and with an average voltage for the period substantially equal to the desired voltage
~~The method of claim 8, wherein a pulse of~~
the first or second switching signals is generated to include an adjustment to the width of the pulse to compensate for a voltage offset caused by a slow response in generating the first or second switching signals.

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15. (currently amended) The method of claim 12, wherein the first and second switches are transistors and the method comprises the step of switching the transistors between on and off states, the on and off states corresponding to substantially minimum voltage drop and substantially minimum current flow respectively through the transistors.

16. (currently amended) A method of generating first and second switching signals for switching first and second switches of a switching circuit that further comprises an output and that receives a DC supply of nominal voltage $+V_S$, and wherein switching between various combinations of on and off states of the first and second switches produces a voltage at the output with pulses at levels of $+V_S$, 0V and $-V_S$:

the method comprising the steps of:

(a) receiving a voltage demand signal indicative of a desired voltage to be supplied at the output in a period; and

(b) generating the first and second switching signals, wherein at least one of the first and second switching signals comprises a single pulse of a determined width within the period, wherein the determined width does not fall below a minimum pulse width, and further, wherein successive transitions between on and off states of the first switching signal or of the second switching signal that occur in different periods are separated in time by a minimum time interval, and wherein the determined width is such that the combination of the first and second switching signals when applied to the first and second switches respectively produce an average voltage at the output for the period that is substantially equal to the desired voltage in the period
The method of claim 1, further comprising the step of receiving a current demand signal indicative of

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a desired current to be supplied to the output in a period and calculating the voltage demand signal indicative of a desired voltage to be supplied to the output that results in an electrical signal being supplied to the output during the period with a current substantially equal to the desired current.

17. (original) The method of claim 16, wherein the step of calculating the voltage demand signal is performed with reference to a model of the load characteristic of a load connected to the output.

18. (previously presented) The method of claim 16 further comprising the step of generating the voltage demand signal with reference to a current signal indicative of the current flowing through the output.

19. (cancelled).

20. (currently amended) A computer program product comprising ~~program code means~~ stored on a computer readable storage medium containing computer readable instructions that when executed implement for performing a method of generating first and second switching signals for switching first and second switches of a switching circuit that further comprises an output and that receives a DC supply of nominal voltage $+V_S$, and wherein switching between various combinations of on and off states of the first and second switches produces a voltage at the output with pulses at levels of $+V_S$, 0V and $-V_S$;

the method comprising the steps of:

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(a) receiving a voltage demand signal indicative of a desired voltage to be supplied at the output in a period; and

(b) generating the first and second switching signals, wherein at least one of the first and second switching signals comprises a single pulse of a determined width within the period, wherein the determined width does not fall below a minimum pulse width, and further, wherein successive transitions between on and off states of the first switching signal or of the second switching signal that occur in different periods are separated in time by a minimum time interval, and wherein the determined width is such that the combination of the first and second switching signals when applied to the first and second switches respectively produce an average voltage at the output for the period that is substantially equal to the desired voltage in the period~~the method steps of claim 1 when the program is run on a computer.~~

21. (currently amended) A switching circuit operable to receive a DC supply of nominal voltage $+V_S$ and that comprises first and second switches, an output and a computer programmed to control the generation of switching signals for switching said first and second signals according to perform the method steps of claim 1 a method of generating first and second switching signals for switching first and second switches of a switching circuit that further comprises an output and that receives a DC supply of nominal voltage $+V_S$, and wherein switching between various combinations of on and off states of the first and second switches produces a voltage at the output with pulses at levels of $+V_S$, 0V and $-V_S$;

the method comprising the steps of:

(a) receiving a voltage demand signal indicative of a desired voltage to be supplied at the output in a period; and

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(b) generating the first and second switching signals, wherein at least one of the first and second switching signals comprises a single pulse of a determined width within the period, wherein the determined width does not fall below a minimum pulse width, and further, wherein successive transitions between on and off states of the first switching signal or of the second switching signal that occur in different periods are separated in time by a minimum time interval, and wherein the determined width is such that the combination of the first and second switching signals when applied to the first and second switches respectively produce an average voltage at the output for the period that is substantially equal to the desired voltage in the period.

22. (original) A switching circuit according to claim 21, further comprising a noise shaper operable to noise shape the first and second switching signals.

23. (currently amended) A switching circuit according to claim 21 comprising a bridge circuit comprisingincluding an input operable to receive a DC supply of nominal voltage $+V_s$, an output and first and second arms having first and second switches respectively, the first and second arms being connected to opposed ends of the output and a computer programmed to control the generation of switching signals for switching said first and second signals~~perform the method steps of claim 8.~~

24. (currently amended) A switching circuit according to claim 23, wherein said bridge circuit comprising~~an input operable to receive a DC supply of nominal voltage $+V_s$, an output and first and second arms having first and second switches respectively, the first and second arms being connected to opposed ends of the output,~~ further comprising a voltage signal sensor

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operable to produce a voltage signal indicative of the DC supply voltage such that the determined pulse width compensates for fluctuations in the DC supply ~~and wherein a computer is programmed to perform the method steps of claim 9.~~

25. (currently amended) A bridgeswitching circuit according to claim 24, wherein said bridge circuit further comprising a filter arranged to receive the voltage signal.

26. (original) A bridge circuit according to claim 25, wherein the filter is a finite impulse response filter.

27-31 (cancelled).

32. (currently amended) A method of generating first and second switching signals for switching first and second switches of a switching circuit that further comprises an output and that receives a DC supply of nominal voltage $+V_S$, and wherein switching between various combinations of on and off states of the first and second switches produces a voltage at the output with pulses at levels of $+V_S$, 0V and $-V_S$;

the method comprising the steps of:

(a) receiving a voltage demand signal indicative of a desired voltage to be supplied at the output in a period; and

(b) generating the first and second switching signals, wherein at least one of the first and second switching signals comprises a single pulse of a determined width within the period, wherein the determined width does not fall below a minimum pulse width, and further, wherein

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successive transitions between on and off states of the first switching signal or of the second switching signal that occur in different periods are separated in time by a minimum time interval, and wherein the determined width is such that the combination of the first and second switching signals when applied to the first and second switches respectively produce an average voltage at the output for the period that is substantially equal to the desired voltage in the periodThe method of claim 1, wherein, at step b), the first switching signal comprises a pulse of the determined width within the period and the second switching signal remains in one state throughout the period.

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REMARKS/ARGUMENTS

Claims 1-18, 20-26 and 32 stand rejected in the outstanding Official Action. Applicant has cancelled without prejudice claims 1, 2 and 8 and amended claims 3-7, 9, 12, 14-16, 20, 21, 23-25 and 32. Accordingly, claims 3-7, 9-18, 20-26 and 32 are the only claims remaining in the application.

The Examiner's indication of PTO acceptance of the previously filed formal drawings is appreciated. The Examiner's clarification of the substance of the earlier Information Disclosure Statement is also appreciated. While Applicant has double-checked and the Japanese document number was identical to that present on the document forwarded from the Japanese Patent Office, Applicant has recently received a more recent Japanese Official Action identifying a different Japanese patent. Applicant encloses herewith an Information Disclosure Statement forwarding the newly cited Japanese reference along with a translation of the Abstract and consideration and entry of this Japanese document is respectfully requested.

While Applicant has cancelled claim 1, the subject matter of claim 1 has been incorporated into a number of claims in order to place them in independent form. The Examiner's correction to the subject matter of claim 1, i.e., changing "time period" to read "time interval" is noted and has been made. Applicant has also clarified claim 15 to make it clear that the on and off states correspond to the substantially minimum voltage drop and substantially minimum current flow respectively through the transistors.

The Examiner suggests that claims 21-23 were incomplete as failing to recite essential cooperative relationships between elements. In rewriting these claims in independent form, Applicant has taken care to recite the proper interrelationship and reconsideration of this

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objection is respectfully requested. With respect to claim 23, the Examiner's assumption is correct and Applicant references the performance of the method steps of claim 21 which recites the method steps formerly in claim 8.

In view of the above amendments, the remaining claims are believed to meet the requirements of 35 USC §112 and any further rejection thereunder is respectfully traversed.

In section 9 of the outstanding Official Action, the Examiner has indicated that claims 3-7, 9-14, 16-18, 20-26 and 32 would be allowable if rewritten in independent form. These claims have either been rewritten in independent form or amended to depend from independent claims. Additionally, rejected claims 1, 2 and 8 have been cancelled without prejudice. Rejected claim 15 is now dependent from claim 9 and therefore allowable. Accordingly, in view of the above amendments, all remaining claims 3-7, 9-18, 20-26 and 32 are in condition for allowance and notice to that effect is respectfully requested. In view of the cancellation of the rejected claims and the apparent allowance of all remaining claims, the rejection under 35 USC §103 has been obviated.

Having responded to all objections and rejections set forth in the outstanding Official Action, it is submitted that claims 3-7, 9-18, 20-26 and 32 are in condition for allowance and notice to that effect is respectfully requested. In the event the Examiner is of the opinion that a brief telephone or personal interview will facilitate allowance of one or more of the above claims, he is respectfully requested to contact Applicant's undersigned representative.

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Respectfully submitted,

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Enclosure:

Information Disclosure Statement